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PATENT SPECIFICATION (11) 1 321 016

DRAWINGS ATTACHED

(21) Application No. 20898/71 (22) Filed 19 April 1971
(31) Convention Application No. P20 06 371.2
(32) Filed 9 Feb. 1970 in
(33) Germany (DT)
(44) Complete Specification published 20 June 1973
(51) International Classification G01N 21/26
(52) Index at acceptance
G1A 247 248 269 323 357 358 369 402 404 405 42X 42Y 43X 43Y 447 448 457 458 463 467 46X 46Y 478 480 49X 520 52Y 53Y 568 569 628 761 782 78Y

(54) APPARATUS FOR DETECTING SMOKE, DUST OR LIKE MATTER

(71) We, EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM), European Center Kirchberg, Luxembourg, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to apparatus for detecting smoke, dust or like matter in a gas by evaluating the absorption of light by the gas.

Detectors of this kind may be used for safety monitoring in rooms in which it is desired to detect the development of smoke or dust. It is important that such apparatus shall provide reliable operation without maintenance over a period of time since such apparatus is often not easily accessible (e.g. mounted on the ceiling of a room or in generally inaccessible rooms such as in the neighbourhood of nuclear reactors).

Known detectors of this kind do not always satisfy the above conditions. The gas is usually conducted through a rectilinear measuring duct and a light beam is passed repeatedly and transversely through the gas by means of reflectors. It has been shown that the reflectors in the measuring duct are readily covered with smoke or dust so that the measured signal drops excessively.

The invention provides apparatus for detecting smoke, dust or like matter in a gas by measuring the absorption of light by the gas, the apparatus comprising a light source, a light detector spaced from the light source, and a duct for conveying gas the duct having a gas inlet and outlet lying between and spaced from the light detector and the light source and the duct defining a zig-zag path leading from the said inlet to the said outlet such that light travelling in a straight line from the light source to the light detector will cross the path at least twice.

The invention also provides a method of detecting smoke, dust, or like matter in a gas measuring the absorption of light by the gas using a light source and a light detector, comprising the steps of causing the gas to move along a zig-zag path without contacting the light source or the light detector, passing a light beam through the gas in a straight line so that it crosses the path at least twice, and measuring the intensity of the light emerging from the gas.

A reduction in the amount of maintenance may be obtained by the apparatus according to the invention by virtue of the fact that no optical element such as reflectors, lenses or the like are provided in the gas path since the gas and not the light proceeds in a zigzag manner. Moreover, a baffle plate may be used which results in a degree of turbulence which homogenises the gas and reduces the chance of faulty indication resulting from local smoke or dust plumes of slight extent.

A particular embodiment of the invention will now be described, with reference to the accompanying figure which shows an example of a smoke detector according to the invention. The detector is provided with a motor 1 adapted to drive a blower 2 as well as a blade-carrying wheel 3. The blower is disposed as a suction blower at the exit of a measuring duct 4; the duct is disposed immediately upstream of a lateral discharge socket 5. The measuring duct substantially comprises an elongate rectilineal pipe of rectangular cross-section. A gas inlet socket 6 conducts gas into the measuring duct in a direction transverse to the axis of the duct whereupon it flows axially towards a measuring section, aided by the blower 2, and reaches the discharge socket 5 via the blower. The measuring section itself has baffle plates 7 disposed therein, each concealing approximately 75% of the effective duct cross-section and being so disposed as to force the gas to assume a

zigzag or meandering path. In the axial zone, each baffle plate is provided with a semi-circular cut out portion to admit an axially aligned light beam.

The optical apparatus comprises a light transmitter 8, the bladed wheel 3, disposed immediately downstream of the light transmitter, and light measuring means 9 disposed at the opposite end of the measuring duct. The light measuring means may comprise one or more photo diodes.

A dust trap 14, comprises a draught-free chamber with only one aperture, for the entry of the light beam through a mating aperture in the duct, is connected to one end of the duct. The light measuring means 9 is mounted in the dust trap. Dust particles which enter the chamber should not contaminate the window of the light measuring means since immediately after entry into the chamber and owing to the lack of draught they emerge downwardly from the zone of the light beam and finally float to the floor of the chamber 14. A similar dust trap is also disposed between the blower and the light source 8 but is not shown in the illustration.

The optical apparatus also incorporates an optical fibre 10, arranged to conduct a part light beam from the light transmitter 8 around the measuring duct 4 to the light measuring apparatus 9. This enables the emission of the light transmitter to be constantly monitored and, where appropriate to be regulated by electronic means. A plate 11 with electronic circuit elements is indicated adjacent to the measuring section, said electronic circuit element being adapted to amplify the electrical signal obtained from the light measuring apparatus for comparison with a set value (alarm threshold).

The apparatus includes electronic controls (not shown), an alarm and an indicator. When the electrical signal from the light measuring apparatus drops below the alarm threshold, thereby indicating that the quantity of smoke or dust has risen above a desired level, the controls cause a warning indicator and an alarm to be actuated.

The set value comprising the alarm threshold may be adjusted by means of a simple knob control (not shown). The blower speed will theoretically influence the point at which the alarm will operate. Thus in a particular apparatus the blower speed may be arranged to be constant, and the threshold control calibrated according to desired criteria. For example one knob setting may be such that a lighted cigarette held at a distance of 1m. from the apparatus will activate the alarm, but held at a distance of 3m. will not activate the alarm.

The apparatus described hereinabove is compact. It incorporates two electric multi-pin plugs 12 and 13 for connection respectively to the motor power supply and to the alarm system. It may therefore be easily installed and may be dismantled for inspection. It has proved its reliability in operation even under the difficult conditions in the immediate neighbourhood of a nuclear reactor.

WHAT WE CLAIM IS:—

1. Apparatus for detecting smoke, dust or like matter in a gas by measuring the absorption of light by the gas, the apparatus comprising a light source, a light detector spaced from the light source, and a duct for conveying gas the duct having a gas inlet and outlet lying between and spaced from the light detector and the light source and the duct defining a zig-zag path leading from the said inlet to the said outlet such that light travelling in a straight line from the light source to the light detector will cross the path at least twice.

2. Apparatus as claimed in claim 1 in which the duct contains at least one baffle plate, the duct having a passage therethrough for the light.

3. Apparatus as claimed in claim 2 in which the duct is elongate and of rectangular cross-section, having an axial aperture at each end for entry and exit of light respectively, the or each baffle plate extending transversely of the duct to cover substantially 75% of the cross-sectional area of the duct, and the or each baffle plate having an aperture or slot therein so that the light may pass through the baffle plate in the direction of the longitudinal axis of the duct.

4. Apparatus as claimed in claim 3 in which the duct has, adjacent each end, a transversely facing aperture comprising respectively the gas inlet and outlet.

5. Apparatus as claimed in claims 3 or 4 in which the light detector is mounted in a dust trap at one end of the duct, the dust trap comprising a chamber connected to one end of the duct so that light may pass from the duct into the dust trap through the axial aperture in the end.

6. Apparatus as claimed in any one of claims 3 to 5 in which the light source is mounted in a dust trap at one end of the duct, the dust trap comprising a chamber connected to one end of the duct so that light may pass from the dust trap into the duct through the axial aperture in the end.

7. Apparatus as claimed in any one of the preceding claims including means to urge the gas along the zigzag path.

8. Apparatus as claimed in claim 7 in which the means to urge the gas comprises a motor driven blower.

9. Apparatus as claimed in claim 8 including a blade arrangeable to rotate and regularly interrupt a beam of light passing from the light source to the light detector.

10. Apparatus as claimed in any one of the

preceding claims in which the light detector is arranged to emit an electric current for measuring purposes when light falls on the detector.

11. Apparatus as claimed in any one of the preceding claims in which at least one optical fibre is arranged to conduct a beam of light from the light source to the light detector so that the beam of light by-passes the zig-zag gas path and may be used to monitor the strength of the light source.

12. Apparatus as claimed in claim 11 in which the strength of the light source is controlled electrically so that when the apparatus is in use and the intensity of the light passing along the optical fibre varies from a predetermined value or range of values the strength of the source is automatically adjusted.

13. Apparatus as claimed in any one of the preceding claims including an alarm which, when the apparatus is in use, is arrangeable to operate when the intensity of the light reaching the light detector via the duct falls below a predetermined value.

14. A method of detecting smoke, dust, or like matter in a gas by measuring the absorption of light by the gas using a light source and a light detector, comprising the steps of causing the gas to move along a zig-zag path without contacting the light source or the light detector, passing a light beam through the gas in a straight line so that it crosses the path at least twice, and measuring the intensity of the light emerging from the gas.

15. Apparatus for detecting smoke, dust or like matter in a gas, substantially as hereinbefore described, with reference to and as shown in the accompanying drawing.

16. A method of detecting smoke, dust or like matter in a gas, substantially as hereinbefore described with reference to the accompanying drawing.

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Chartered Patent Agents,
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1973.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1321016 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*